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FUNCTIONAL HARDWARE AND SOFTWARE SPECIFICATIONS FOR THE
MODEL TRAINING PROGRAM FOR RESERVE COMPONENT UNITS

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FUNCTIONAL HARDWARE AND SOFTWARE SPECIFICATIONS FOR THE MODEL TRAINING PROGRAM FOR RESERVE COMPONENT UNITS

EXECUTIVE SUMMARY

Requirement:

The Model Training Program for Reserve Component Units (MTP-RC) is developing and evaluating state-of-the-art, computer-based troubleshooting and maintenance instruction. The purpose of this report is to describe the hardware and software systems that will be required to deliver this training to Reserve Units. The report also contains information pertaining to the delivery of MTP-RC courseware on the Electronic Information Delivery System (EIDS) and on strategies for supplementing MTP-RC courseware with the Hand Held Tutor.

Procedure:

MTP-RC courseware was analyzed in order to identify those characteristics that were dependent on specific hardware and/or software capabilities. General computer-based training hardware and software requirements are also identified.

To determine the degree to which MTP-RC courseware is compatible with EIDS, Army agencies were contacted in order to identify the functional specifications for EIDS hardware and software. The proposed EIDS characteristics then were compared to MTP-RC courseware delivery requirements to determine the level of courseware compatibility.

In order to determine how the Hand Held Tutor could be used with MTP-RC courseware, two tasks were performed. First, the characteristics of the Tutor were identified. Second, MTP-RC courseware was analyzed in order to identify instructional requirements for which these characteristics would be appropriate.

Results:

MTP-RC courseware was developed for delivery on the MicroTICCIT CBT system. As a result, the hardware and software specifications describe the capabilities of MicroTICCIT.

At the present time, the functional specifications for EIDS are not available. As a result, it is difficult to determine the level of compatibility between MTP-RC courseware and EIDS.

The analysis of the Hand Held Tutor indicates that there are several ways in which this device could be used to supplement MPT-RC courseware. Utilization strategies include training on tank nomenclature, use of the technical manuals, and equipment locations.

Utilization of Findings:

The findings will be used as the basis for selecting an MTP-RC delivery system (MicroTICCIT) and planning for the fielding of MTP-RC courseware in Reserve Units. Additionally, the results will help guide the integration of several training devices (CBT, EIDS, Hand Held Tutor) to form an integrated training system.

FUNCTIONAL HARDWARE AND SOFTWARE SPECIFICATIONS FOR THE
MODEL TRAINING PROGRAM FOR RESERVE COMPONENT UNITS

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INTRODUCTION

The Model Training Program for Reserve Component Units (MTP-RC) is developing and evaluating state-of-the-art, computer-based troubleshooting and maintenance instruction. The goal of the training program is to sustain skill level 1 and 2 troubleshooting and maintenance proficiency on the M1 Abrams main battle tank. The target audience includes two Organizational Military Occupational Specialties (MOSs), 45E and 63E, and two Direct Support/General Support MOSs, 45K and 63H, in RC units which have CAPSTONE assignments as M1 support units. Computer-based training and simulation may be particularly appropriate for these units, as they typically do not have M1 tanks available for training at their home stations.

The MTP-RC courseware consists of four partial courses which train tasks selected by ARI from the respective MOS critical task lists. Each course comprises approximately 1/3 of a complete skill level course for the MOS. A front-end analysis of the selected tasks identified the skills and knowledge required to perform the tasks. Course syllabi were then developed, and instructional strategies appropriate to the training objectives were selected prior to production of the courseware.

The purpose of this report is to describe the functional specifications of the MTP-RC software and hardware required to deliver the courseware. The report also discusses how the MTP-RC design strategy could be adapted for use with the Hand Held Tutor (HHT) and the Electronic Information Delivery System (EIDS), as currently specified.

Future information regarding system implementation will affect the ultimate requirements of the delivery system including: the number of courses delivered at one site, the level of proctor/operator skills, and the scheduling needs of the RC sites. Therefore, the recommendations made are likely to change as this and other projects develop. This report will, however, provide recommendations based on current information about the necessary specifications for the delivery system as a function of the training requirements of RC units and the solutions provided by the MTP-RC courseware.

Instructional Approaches Appropriate for RC Training Environment

The unique challenges of the RC Training Environment have driven the development of training materials for the MTP-RC. As a result, the courseware development process has used new design strategies and state-of-the-art courseware authoring and delivery techniques. The five environmental factors that influenced the design and development of MTP-RC courseware are described below.

One challenge which the RC training environment presents involves the extremely limited and sporadic time available for training. Substantial time gaps between training sessions and intermittent availability of

soldiers during reserve training periods necessitate that the training promote rapid skill acquisition and retention over substantial periods of time. Optimally, training should allow students to spend as much time as possible with the courseware, rather than using training time to learn to use a complicated delivery system.

Uniformity in the structure and flow of the delivery can also enhance training efficiency, and the MTP-RC courseware is structured to maximize familiarity with training flow. Soldiers can easily pick up where they stopped in a prior session or review earlier material. Each new segment is linked directly to those that came before to form an integrated whole, rather than an unrelated sequence of instructional presentations. Finally, the interactive nature of the courseware promotes active student responding which has been demonstrated to increase motivation, receptivity and retention (Mager, 1978; Fleming & Levie, 1978).¹

A second challenge presented by the reserve training environment is that there is little or no access to M1 tanks during the training process. Therefore soldiers must acquire the necessary skills without actually working on the equipment. To address this problem, the courseware presents graphic and video images that are highly realistic while requiring student interactions that simulate as accurately as possible real troubleshooting and maintenance actions.

A third RC training challenge concerns the limited access soldiers have to experienced trainers. This is particularly a problem with the introduction of new equipment such as the M1 tank, where trainers are likely to be as inexperienced as trainees. Computer-based instructional techniques allow maintenance training expertise to be incorporated into the courseware. The MTP-RC training is designed to function without the presence of trainers, at a rate which is individualized and self-paced. Each soldier can study what he wants, for as long or as short a time period as his learning requires.

A fourth challenge is to enhance MOS skill retention for the reserve forces. MOS skill retention is supported by the simulated maintenance interactions required by the courseware. RC soldiers may also be motivated by the graphics and video used in the courseware, and heightened motivation can lead to greater skill retention.

A fifth challenge of the RC training environment is the need to maintain systematic records of student needs and readiness. The MTP-RC, using MicroTICCIT's computer-managed instruction capabilities, can provide meaningful milestones for students and tracking of individual and group progress. Periodic reports can be generated for use by RC leadership to assist their evaluation of individual and unit readiness.

¹Mager, Robert F., 1978, Developing Attitude Toward Learning, Pitman Learning, Inc., Belmont, California, and Fleming, M., and Levie, W.H., 1978, Instructional Message Design: Principles From the Behavioral Sciences, Englewood, N.J., Publications.

MTP-RC COURSEWARE DESCRIPTION

The MTP-RC courseware is structured in such a way as to be compatible with the MicroTICCIT Computer-Based Management System. Each course -- one for each MOS -- is divided into 3 instructional categories:

Units - One for each tank system covered in the course

Lessons - Two for each unit within a course

Segments - One for each instructional objective being taught within a lesson

Figure 1 shows the flow of instruction within a specific MOS course. There is, in addition, one course which provides M1 skills sustainment training. The content of this course and a general description of the instructional structure of the MOS courses follows.

The M1 Skills Sustainment Training Course is divided into two units. Unit 1 serves as an introduction to the M1 tank, the MicroTICCIT CBT system, and the structure and content of the MTP-RC courseware. Unit 1 also includes instruction on how to use the MicroTICCIT student workstation to complete the courseware.

Unit 2 is designed to provide RC soldiers with the skills and knowledge that are prerequisite to successfully complete the MTP-RC courseware. For those who have completed Level 1 training, this unit can be considered as sustainment training; it sustains skills that have been acquired previously. However, for those who have not acquired the necessary skills, Unit 2 will serve as prerequisite skills training. Topics covered in this unit include use of technical manuals, use of the special test sets (e.g. STE-M1, DSESTS), and Digital Multimeter.

As Figure 1 shows, Units comprise the tank systems covered in a course. Instructional structure begins to evolve at the lesson level. There are, in each course, two lessons: Principles of Operation and Troubleshooting or Maintenance. These are explained below.

Principles of Operation

The Principles of Operation lessons are designed to provide students with an understanding of the purpose and function of a tank system, its component parts, and its general operation. Such information should assist the student in troubleshooting selected system symptoms. This lesson has one or two types of segments, depending on the complexity of the system: Name, Location, Function (NLF) and Input, Process, Output (IPO).

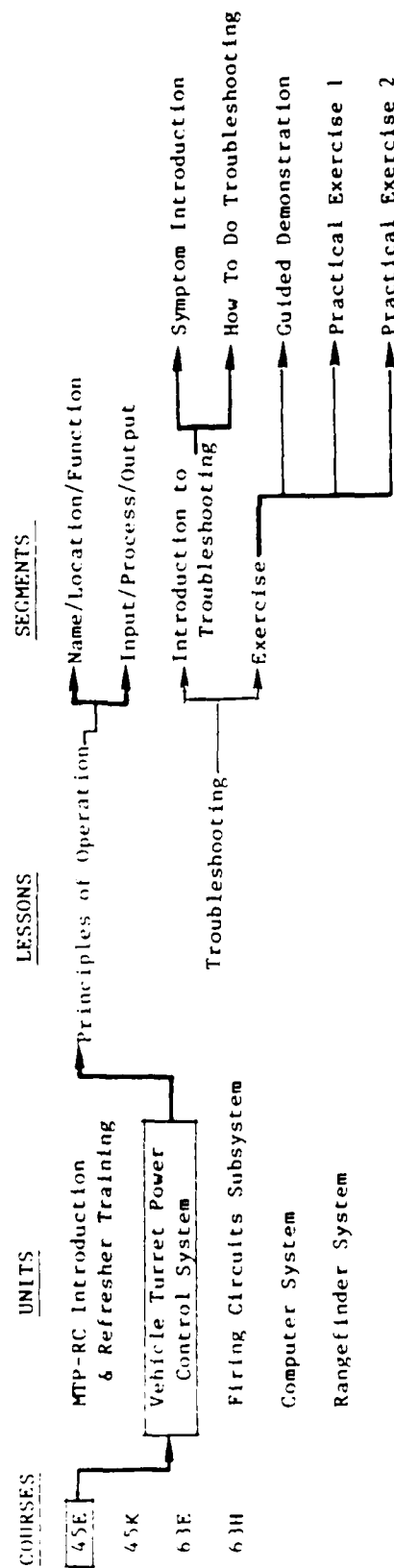


Figure 1. Flow of instruction.

Name, Location, Function. The primary purpose of the Name, Location, Function segment is to teach the name, functional location and function of each of the important components of a single tank system. The student learns the function of the entire system, how the components work together in the system, and what happens if the system is not working correctly. In this segment, the student is presented with a functional block diagram of the entire system. This diagram shows the functional relationship among the components in the system, so the student learns the functional position of the component in relation to the others. In a few systems, such as the engine, the student also learns the actual physical location. After selecting an individual component, the students see a video or graphic image of the component and a brief description of its function. All system components are studied in this manner. The student then demonstrates what he has learned by completing a practice exercise in which he identifies the name, location and function of each component. At the end of the segment, the student reviews what he has learned.

The Name, Location, Function segment utilizes a number of sophisticated delivery techniques:

1. Video is used to enable students to see the actual tank parts and place them in the context of the whole tank.
2. High resolution color graphics are used for motivational purposes to help students easily identify each part, and to show the relationship using the components within the system. Highlighting is often employed to enhance the clarity of the graphics.
3. Graphic icons and a lightpen are used so movement between and among segment pages is consistent, easy to understand, linear in appearance, and to make "help" easily accessible at all times.
4. Menu color coding provides students with information related to segment completion status. Different colors are used to identify segment components that have been completed successfully, those that are available for study, and those that can be studied later.

Input, Process, Output. The Input, Process, Output (IPO) segment is designed to accomplish two specific goals. First, information about each system part is presented in greater depth than in the NLF segment. In the IPO segment, soldiers learn about:

1. those elements (electricity, data, fuel) that come into a part and the sources of those elements
2. what happens to those elements while in the part, and
3. the elements (power, data) that are output by the part and the destination of those elements.

For example, a computer might receive data from three electronic sensors. These data comprise the INPUT. Then, the computer performs a clearly defined set of mathematical operations on these data. The results are then evaluated. This represents the PROCESS. The computer sends signals to three other tank parts. The signals represent the OUTPUT. By studying the NLF and IPO for any part, the soldier learns what the function of the part is and how this function is accomplished.

A second, and no less important, goal of the IPO segment is to reinforce the concept of the tank as an integrated system. While the NLF segment focuses on one system or subsystem, the IPO segment shows the relationship among several systems. The reason, of course, is that input and output is not limited to a specific system. Rather, it is the input and output of parts, subsystems, and systems that embodies the integration of all tank systems.

IPO segments employ the same delivery techniques as NLF segments.

Troubleshooting/Maintenance

The second lesson in each unit is Troubleshooting/Maintenance, which uses part-task simulations of troubleshooting and maintenance tasks. There are two segments within each Troubleshooting/Maintenance lesson: Introduction to Troubleshooting and Troubleshooting/Maintenance Exercises. For the 45E, 63E and 45K, the simulations are mainly electronic troubleshooting and for the 63H, mainly mechanical maintenance procedures. This content reflects the principal skill level 2 critical tasks for the respective MOSs.

Introduction to Troubleshooting. The first segment, Introduction to Troubleshooting (or Maintenance), provides a transition between the Principles of Operation segments and the simulations the student will perform. The introduction consists of two sections: Symptom Introduction and How to do Troubleshooting.

In the Symptom Introduction, the system diagram presented in the Principles of Operation lesson serves as the foundation on which troubleshooting knowledge is built. All of the components which could not be responsible for the symptom are deleted from the diagram, and components outside the system which could cause the symptom are added. This provides the student with the "feasible set" of all possible causes of the fault. The student then learns how each component could cause the fault and what tests will be performed in order to isolate the fault. The Symptom Introduction also includes a review of the rules that must be applied while completing troubleshooting simulations.

The troubleshooting approach presented in the introduction models the cognitive processes of experienced troubleshooters and can help students develop the ability to locate system components that could cause a fault. The approach may lead some soldiers to develop skills and knowledge necessary for becoming superior technicians. For other students, the intro-

duction will provide understanding of why specific tasks are being performed and will illustrate the relationship between symptoms that occur within the same system.

The second section of this segment, called "How to do Troubleshooting", is the same in every lesson. Its purpose is to teach the student how to use the troubleshooting simulation. This section is always available for students in need of review. It consists of a short description of how Guided Demonstrations and Practical Exercises work and two sections which explain how the student will interact with the Technical Manuals (TMs) and the computer.

Troubleshooting Exercises. The troubleshooting exercise segments generally consist of three sections: Guided Demonstration, Practical Exercise 1, and Practical Exercise 2. All exercises are based on the MI TMs. The student is required to use the appropriate TM as a constant job aid when performing troubleshooting actions. MicroTICCIT provides the tank and test equipment, as well as help, prompts, and explanations.

The Guided Demonstrations (GDs) and Practical Exercises (PEs) cover the same symptom but follow different paths through the troubleshooting procedure and lead to different faults. This approach enables the student to repeat some steps within a procedure as well as performing new steps. The goal of the troubleshooting exercises is for the student to simulate troubleshooting a fault symptom using the TM as a job aid. The student is not expected to memorize the steps required to troubleshoot a particular symptom, but rather is expected to understand the use of the TMs for troubleshooting symptoms.

Student Interactions with the Simulation. The main part of the screen, called the work area, displays detailed graphics showing the tank, system components, and test equipment. It is in this area that the student locates his workplace, identifies the required components, and performs tests and checks. Continuous guidance is provided on a feedback line. Below this line are both action icons (such as remove, replace, connect) and tool icons (such as the breakout box, cables, adapters and jumper cables). The electronic troubleshooting procedures are presented with computer generated graphics, while the maintenance procedures (63H) primarily use videodisc images.

The student is required to follow the TM word-by-word, completing each step by marking with the light the appropriate component, actions, and tools. After each action, the display changes in whatever way the student has indicated as long as he continues to mark correctly. When the student makes a mistake, he receives immediate corrective feedback and cannot continue until the correct step has been completed. The student continues through the procedure until he finds the fault. He then orders the replacement of the faulty component and verifies that the problem is solved.

Throughout the troubleshooting, the two kinds of help available to the student are:

1. what to do next if he gets lost or does not know what to do, and
2. reminders on how to use the simulation and icons.

Several features of the troubleshooting simulation have important implications for the specification of an instructional delivery system:

1. Graphic representations of equipment can be effective for training the type of tasks included in M1 troubleshooting (Dwyer, 1978).² Video images were not selected for troubleshooting for several reasons. First, the cost of producing separate video shots as potential responses to over 150 screen marks for each simulation was prohibitive. Second, the complexity of aligning successive video images to avoid position changes on the screen which would distract the student from the appropriate cues and changes would have made courseware production unacceptably inefficient. For maintenance simulations, video displays were chosen because the graphics required to maintain a continuous realistic context of the mechanical procedure, including task cues, would have been extremely difficult to produce.
2. Considerable data storage space is required for the graphics and software necessary for such an intensive and complete simulation. Each troubleshooting segment requires between 3-6 megabytes of storage in object (or compiled) form.
3. Based on current estimates of lesson size, it seems likely that one MTP-RC partial MOS course could be stored on a 50 megabyte disc. If the partial courses of the Model Training Program are expanded to cover the entire MOS skill level 20 tasks, storage requirements would approximately triple.
4. Several colors are needed to represent the equipment and related instructional information. On some equipment, colors are required for recognition of indicator lights. Such colors must be used in simulations as initiating cues. Instructional messages are color-coded to indicate performance accuracy. For example, after a correct mark the student receives feedback in a green text field. After an incorrect response, the text field is red.
5. MicroTICCIT provides two student input devices; the keyboard and a light pen. The light pen was selected as the primary input device for two reasons. First, the MicroTICCIT keyboard is complicated and has keys that are based on an instructional strategy that was not used in MTP-RC courseware. Second, all MTP-RC courseware requires students to make selections from menus, tools, tank

²Dwyer, Francis M., 1978, Strategies for improving visual instruction. State College, Penn.; Learning Services.

parts, and locations. In each case, marking the screen with a light pen seemed to be the most natural input option and the one which required the least amount of training.

6. Since using the TMs is a requirement of the training program, there must be adequate space for keeping the TMs and handouts open while working at the terminal.

MTP-RC DELIVERY SYSTEM REQUIREMENTS

The delivery system which is used for MTP-RC courseware should be able to handle the variety of innovative requirements included in the courseware design, as well as requirements dictated by the training environment itself. These requirements can be grouped into five main categories: hardware, software, site support, system configuration, and work-station design. Requirements for each of these, as well as our recommendation for the delivery system, will be discussed in some detail below.

Hardware

Several facets of the required hardware will be discussed: display capabilities, student input requirements, and storage requirements.

The primary display device will be a high resolution color video monitor, with screen resolution of no less than 430 X 204 pixels. The system software should be capable of generating displays with the following characteristics:

1. Seven foreground and four background colors for both text and graphics.
2. Text and graphic overlay of video images.
3. Assignment of text, graphic, and video images to specified windows.
4. Ability to color specified portions of text, graphic, or video images.
5. Ability to generate professional quality audio signals for the narrated portion of the videodisc.

A high resolution display is essential for realism and flexibility in creating images that provide a high degree of detail and accuracy. The integrated use of color, text, graphics, and video supports the presentation of real equipment images that can be highlighted for emphasis or modified slightly to make an instructional point. MTP-RC courseware makes extensive use of all of the display capabilities described above and significant portions of the instructional content would be lost without them. For example, if the capability to overlay text and graphics on video images was unavailable, many highlighted action cues in the maintenance simulations could not be displayed to the student.

Two types of student input are required. First, students must be able to identify themselves to the system and gain access to the appropriate instructional material. A standard alphanumeric keyboard can serve this function. It should be noted that alphanumeric input is never required in

the courseware. After the student has entered his identification number, the keyboard can be disconnected and removed until he is ready to log off. Second, students must be able to mark specific windows on the video monitor to indicate a response. This input device must be readable at the single character (10 X 12 pixel) level. Any standard auxiliary input device (lightpen, mouse, trackball) is appropriate.

Should the auxiliary input device malfunction, the keyboard must be capable of assuming the same function through the use of dedicated cursor control and screen mark keys.

The system should be capable of having all courseware available concurrently to allow students access to lessons and to avoid loading operations. This requirement must be weighed against the cost of such storage. Estimate of the amount of storage required for the partial courses being developed for the Model Training Program range from about 24 megabytes to nearly 40 megabytes per course, depending on the number of troubleshooting segments in the course. An additional 7-10 megabytes is required for the operating system. A MicroTICCIT delivery system with 50 megabytes of storage would not be capable of storing either the organizational (63E and 45E) courses or the DS/GS (63H and 45K) unit courses simultaneously.

An additional hardware issue that must be considered is the requirement that each delivery system must be capable of loading and unloading courseware and management files for shipment to other sites. The 15 megabyte tape system on current MTP-RC MicroTICCIT systems is a viable option.

Software

Software requirements fall into two major categories, courseware delivery and courseware management. Each of these areas is described below.

Courseware Delivery. The courseware delivery system should be capable of delivering the MTP-RC courseware described in the previous section and analyzing student input. The only form of student input used in MTP-RC courseware is the screen mark. As a result, the system must be capable of reading the location of a student's mark, comparing that location to one or more locations defined by the courseware author, and then branching the student to another display. This analysis should be completed rapidly and without noticeable delay.

Courseware Management. Courseware management capabilities required by the system include student progress/status reports which are automatically maintained to track student performance. One task of Phase II is to determine what student progress data is required by the reserve component units. Unit reports, which combine student progress reports to determine unit training and readiness, may also be required. Item and test analysis reports are useful to the instructional designers to allow them to revise and refine the courseware, but are not required. Registration is another required feature which provides a simple and secure way for the proctor to

register additional students when they become available for training. A related issue is security. The system shall provide a means for maintaining the security of student performance data and all courseware files.

Site Support

Support needs for the system include service and maintenance of the system, including the need to compensate for the lack of experienced operators. The system contractor should provide hotline service for urgent problems and respond in a timely manner (within 48 hours) to written requests for support. The system should include diagnostic software to aid operators in communicating with the suppliers customer service personnel. It shall contain a modem to allow for the remote performance of diagnostics.

The contractor must provide operator, manager, instructor, and student training and all documentation, including user's guides, system reference manuals, and service and maintenance manuals. If these support requirements are not met most efficiently by the system manufacturer, then other contractual arrangements should be made.

System Configuration and Work Station Design

The exact physical configuration of any one system will be based on the needs of the particular Reserve Unit. Either stand-alone systems or small local area networks should be available.

The work station design should be ergonomically satisfying. It will include an adjustable screen which can be placed at the appropriate height and angle for maximum comfort, a lightpen to be used for interaction, a detachable keyboard used only by the proctor to log on and off the system, maintenance procedure manuals within easy reaching distance, and videodisc and central processing units which are placed well out of the student's way. Also, a comfortable swivel chair is suggested. Aesthetics of the work station are an important consideration. A proposed work station design is shown in Figure 2.

Recommended Delivery System

All MTP-RC courseware has been developed on the MicroTICCIT CBT system. Because MicroTICCIT operates on a proprietary operating system, MTP-RC courseware will not run on any other CBT system. As a result, MicroTICCIT must be the MTP-RC delivery system, using the system configuration that meets most closely the training delivery requirements.

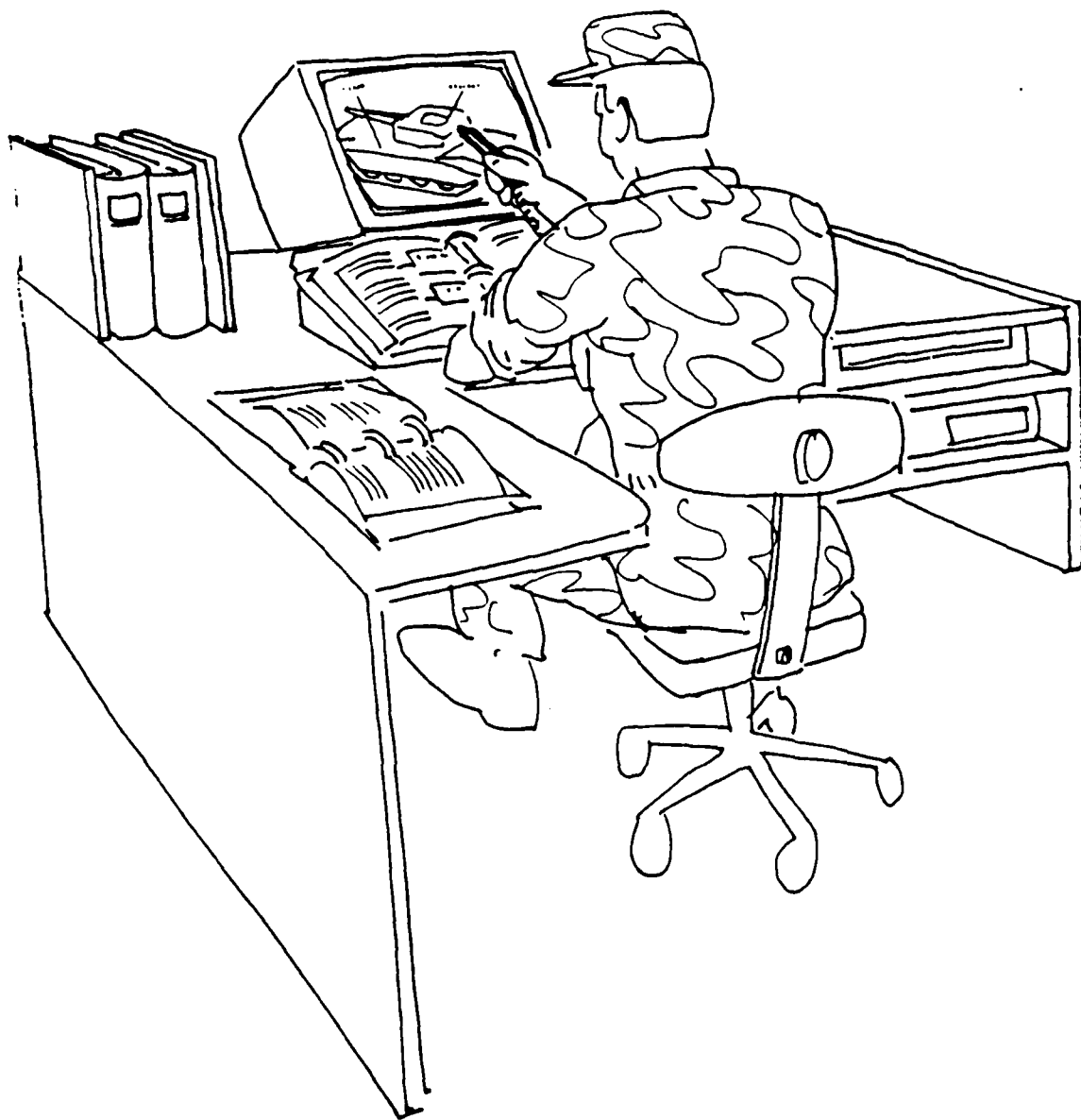


Figure 2. Proposed workstation design.

EIDS INTERFACE

At the time of this report, specifications for EIDS hardware and software have not been released. Therefore, it is difficult to ascertain the level of MicroTICCIT/EIDS compatibility. The EIDS system will, however, most likely feature a videodisc-based storage capability. It is possible, therefore, to discuss in a general way what might be required to convert the courseware for delivery on a system using videodisc storage and to suggest some possible gains and losses from such a conversion.

A videodisc-based digital storage system has a great advantage in that it has a very large storage capacity, approximately 700-800 megabytes. A single disc could easily store all of the program code for current MTP-RC courseware. It should be noted, however, that more than one disc would still be required to deliver MTP-RC courseware because several lessons rely heavily on video images. The current courseware, which is approximately one-third of the courseware required for complete courses for the 4 MOSs, requires four 54,000-frame disc sides for video storage. Nonetheless, the limitations of system disk storage that have existed during this project could be diminished were videodisc storage available.

Since the main limiting factor in courseware storage is the cost of the memory, using optical media instead of magnetic media (task and disk) has the potential to dramatically reduce the cost of a delivery system for the MTP-RC courseware. Such a cost reduction would, of course, depend on the type of hardware required for an EIDS delivery environment.

Another advantage of the videodisc is its stability as a storage medium compared to magnetic media. Discs are, in effect, a ruggedized courseware transfer and storage medium, much less susceptible to the physical damage of heat, dirt, and magnetic distortion possible at a maintenance site or in transit to these sites.

Converting MTP-RC courseware to videodisc could have some drawbacks which should be considered. The first issue concerns the screen displays presented to the student. The troubleshooting/maintenance segments have been designed and coded so that when a student makes a screen mark, the display remains the same except for the specific changes called for by the mark. If all coding were stored on videodisc, it is possible that the entire screen display would be blanked while the disc player searches for the new branching code on the disc, forcing the student to examine the entire screen for cues when in fact, only a few changed highlights require student attention. The likelihood of such screen blanking would depend on the actual operating system developed, the format of storage on the disc, and the amount of storage required for screen display information in the central processing unit. It is quite likely, however, that when the base display is a video image, screen blanking would occur often.

Converting MTP-RC courseware to EIDS would require remastering of the videodiscs, both to make room for the program logic and to reorganize the

video frames on the disc for maximum storage and retrieval efficiency. While this task is not prohibitively expensive, on a one-time basis, the costs would become a factor as courseware revisions were required as a result of M1 hardware reconfiguration or TM changes.

Any change in courseware would require producing a new master tape, pressing a new master disc, and making the disc copies. Such costs must be compared to the costs of implementing similar revisions using the current magnetic storage system.

The collection of student performance data is an issue that must be considered when evaluating EIDS as an MTP-RC delivery system. The MicroTICCIT system has space for student records which can be called up and reported at any time for individual students or groups of students. These reports can be recorded and transferred on magnetic tape, if desired. To maintain student records for units, EIDS hardware must include some capacity for accumulating and reporting student performance data.

A more comprehensive examination of the advantages and disadvantages of converting the MTP-RC courseware for delivery on EIDS can only be completed after a detailed examination of the EIDS hardware and software specifications.

HAND HELD TUTOR APPLICATIONS

The Hand Held Tutor (HHT) could supplement the MicroTICCIT courseware system by delivering drill and practice on the content of the Principles of Operations lessons and on subtasks of the Troubleshooting/ Maintenance lessons. The tutor can assist soldiers in continuing their learning progress when they are away from the main MTP-RC instructional environment, can offer remediation for soldiers identified as deficient in knowledge of the tank systems, and can provide review of instruction previously taken on MicroTICCIT.

Although the HHT is not designed to deliver video, graphics, multiple lines of text, screen marking, and all the other features included in the courseware design, it is possible to suggest how the design approach used in the MTP-RC courseware could be used on the tutor and how some of the MTP-RC lesson content and tests could be rewritten for presentation on the tutor. In this section, we will give some examples of how various HHT presentation modes could be used for MTP-RC lesson content.

Implementation of the suggestions in this section would require several types of developmental efforts. First, these suggestions would require completely new programming to run HHT lessons because at this time, lessons developed on the MicroTICCIT authoring system (or almost any other system) cannot be automatically downloaded to HHT storage chips. Second, the Army would need the capability to produce individual program modules for the HHT. Third, implementation of any of these suggestions will probably require substantial rewriting of the MTP-RC lesson content to conform to the HHT formats. Nonetheless, the value of HHT applications may warrant such efforts to revise the courseware, write new coding and produce the program modules.

Word War is one popular mode of the HHT. This mode could be used for refresher training on the nomenclature for the M1 systems and line replaceable units (LRUs). This type of practice could be especially valuable for soldiers for whom several months have passed since advanced individual training (AIT) with little M1 maintenance experience in their unit. The tutor could display a word or phrase and then the acronyms, such as "Hull Power Distribution Box--HDB, HPD, HNB," and ask the student to select the correct acronym. A similar format could be used for sophisticated terminology associated with a particular system such as the computer subsystem of the fire control system, with the terms presented on the digital display or spoken and the choices of meanings presented in the booklet mounted on the tutor.

The Picture Battle mode of the tutor could be used for review of more complex content from the Principles of Operations lessons by mimicking the practice section of a Name, Location, Function segment. For example, the HHT could speak the name of one of the LRUs in an M1 system when the booklet is open to a functional block diagram; on the diagram, the LRUs would be identified only by number, not by name. The student could

identify the functional position of that LRU in the system by entering its number. This response is similar to marking the LRU on the screen in the NLF segment. A similar format could be used for practice on the content of an Input, Process, Output segment.

The graphics-intensive design of the Troubleshooting cannot be so readily adapted for practice on the hand held tutor, but some parts of the procedure could be practiced. For example, when a student is following a TM procedure for inspecting electrical connectors, the LRU and attached cables could be displayed with the components identified by numbers. To practice following the TM instructions, the student would enter the numbers of the appropriate connectors in sequence. Obviously, the MTP-RC courseware's graphic response to every student input could not be delivered by the HHT, but the tutor can give practice in locating components, an important subtask in troubleshooting.

The tutor could also display the results of a specified multimeter test, just as the multimeter display itself, and ask the student to enter the number of the correct next block in the sequence. The tutor could also be programmed to present a series of questions about the procedure, focusing especially on references to related TMs for preliminary procedures or follow-on maintenance. It would be possible to link together a series of these different types of troubleshooting substeps to allow a student to practice a portion of the procedure. Although detailed item analysis of individual student's MTP-RC input is not planned, it would be possible to direct students to HHT programs for practice of those subtasks on which mistakes are most frequent, such as marking an incorrect cable pin.

These examples of possible uses of the Hand Held Tutor to supplement MTP-RC courseware suggest that the tutor could be a valuable adjunct for practice of some of the knowledge and skills taught in the courses, even though the limited graphics ability of the tutor disallows the delivery of courseware with the designed graphic interaction. Preliminary trials of MTP-RC lessons suggest that these graphic interactions are highly motivating for students and that they reinforce habits required for successful troubleshooting with the M1 SPAS manuals. The drill and practice capabilities of the tutor seem more readily applicable for the cognitive content of the Principles of Operations lessons?

CONCLUSION

The courseware developed for the MTP-RC was designed to meet the challenges of the RC training environment. The lack of dedicated systems operators and trainers require easy access to training materials and simple interactions with the system. The delivery system should therefore be rugged, easy to operate and maintain, and adaptable to the varying needs of the RC units. This report has described the MTP-RC courseware and the functional specifications for the hardware, software, data storage, student recordkeeping, delivery, and work station requirements. At this time, no existing stand-alone systems exist which can deliver the MTP-RC courseware as designed. The MicroTICCIT system most closely matches the identified requirements and is recommended as the primary delivery system.

Two other instructional systems with which the Army is developing delivery capabilities have been discussed: the Electronic Information Delivery System and the Hand Held Tutor. Conversion of the MTP-RC courseware for delivery on the EIDS system has been discussed, including possible advantages and disadvantages of such a conversion. In addition, several suggestions have been given to exemplify the use of the HHT as a supplement to the main delivery system.